AGENDA

- INTRODUCTION
- CELLS AND COMPONENTS
- PV PERFORMANCE
- PV APPLICATIONS
- CODES AND STANDARDS
- EMERGENCY RESPONSE

"Is it fact, or have I dreamt it—that, by means of electricity, the world of matter has become a great nerve, vibrating thousands of miles in a breathless point in time."

Nathaniel Hawthorne, The House of the Seven Gables, 1851

Objective

To cite historical milestones in the development of PV's

To recall the factors that effect PV performance

PV PERFORMANCE

PV Historical Brief

1839	French scientist discovers the photovoltaic effect
1873	Will Smith discovered the photoconductivity of selenium
1876	Discovered selenium produces electricity when exposed to light
1905	Einstein published his paper on the photoelectric effect
1918	Polish scientist developed a way to grow single-crystal silicon
1954	Bell Labs developed the silicon photovoltaic (PV) cell
1958	Vanguard I space satellite used a small array to power radios

PV PERFORMANCE

PV Historical Brief

1962	Bell Telephone Laboratories launches the first telecom satellite
1964	NASA launches satellite powered by a 470-watt PV array
1982	One megawatt power station goes on-line in Hisperia, California
1982	Worldwide photovoltaic production exceeds 9.3 megawatts
1983	Arco Solar dedicates a 120 acre 6-MW PV substation
1984	SMUD commissions its first 1-megawatt PV facility
1999	Cumulative worldwide PV capacity reaches 1000 megawatts

PV PERFORMANCE

PV Performance

Limitations on technology: PV only converts as much as 20% of the suns energy

Environmental factors: overcast days caused by clouds and smog can lower system efficiency

Shade: chimneys, trees and nearby buildings shade panels and reduce the output for the entire array

Temperature: PV systems operate best at 90 degrees or lower

PV PERFORMANCE

PV Performance

Site Specific: availability of sunshine throughout the year, including average daily insolation, site latitude, magnetic declination (true south), tilt angle and site specific information such as local weather and climate

Design: Installers underestimate the rated PV module output by 15 to 25% from the manufacturers tested output, some energy is lost as heat in the DC-AC conversion

PV PERFORMANCE

PV Concepts

Voltage is the measure of electrical potential between two points

Amperage is the rate at which the electrons flow through the circuit.

Wattage is the rate an appliance uses electrical energy, or rather the amount of work done when one amp at one volt flows through one ohm of resistance

PV PERFORMANCE

PV Concepts

Ohm's Law is a mathematical equation
to calculate the value of these terms

The Ohm's formula is:
Volts x Amps = Watts

You can flip this equation around to find other values

Watts ÷ Amps = Volts
or
Watts ÷Volts = Amps

PV PERFORMANCE

PV Concepts

Ohm's formula is used to calculate energy demand and for PV design

Watt-hour measures energy being used

One thousand watts consumed over the period of one hour is one kilowatt hour, (or kWh)

Installers will analyze the energy usage and customer expectations

Energy conservation plays a significant role in PV performance and customer satisfaction

SUMMARY

The physics of electricity never change, regardless of how the electricity is generated.

There are a number of factors that affect overall PV system performance including the technology itself.

Recognizing these factors is another key to personnel safety when working around PV systems.